MODULE 7
INTRODUCTION TO MAP CONTOURING

OBJECTIVES

At the completion of this module, the student will be able to:

1) Perform a contour analysis of a simple meteorological field
2) Apply contouring skills to surface weather maps
3) Practice basic contour-drawing techniques

INTRODUCTION

A critical skill used in severe weather forecasting is the analysis of surface and upper-air maps. As will be explained in Modules 7 and 8, a tremendous amount of meteorological information is contained in the various numbers and symbols which appear on weather maps. Along with interpreting the data shown at the various observing locations, forecasters gain insight into the meteorological patterns and parameters which are present by performing a **contour analysis** on these maps.

What exactly is contour analysis, aside from a way to make a spaghetti-like pattern on an originally clean weather map? Basically, contouring is a method of depicting a meteorological field over an entire map, including the important areas between the observation locations. Each contour represents a line along which a meteorological value is constant. The value is higher on one side of the line and lower on the other side. Contours can be drawn for any number of weather parameters. Temperature, dew point, pressure, and wind speed are some of the more common analyses which are done.

Many of you have probably seen a topographic map. Topographic maps are contour maps showing the elevation of the earth's surface above (or below) sea level. Linear patterns of the elevation contours may suggest a ridge line or a valley. Circular "bullseyes" of contours suggest an area of locally higher (mountain peak) or lower (valley) terrain. We can analyze and interpret similar patterns on weather maps.

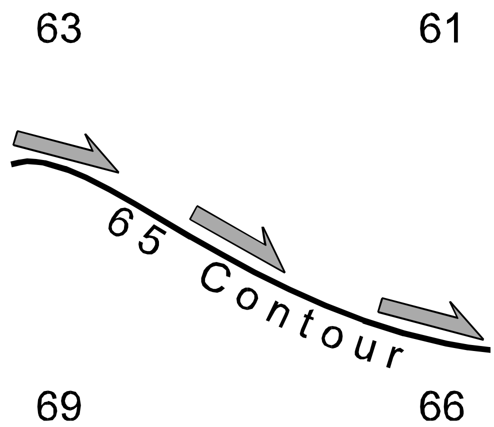
CONTOURING BASICS

Contour analysis is really nothing more than a serious game of connect-the-dots. Although there are many different methods for drawing the contours, here are a few guidelines to help get you started.

- Most analysts start with either the lowest or highest contour values on the chart, then work up or down through the remainder of the values.

- Almost all contours should be smoothly curved. The exception to this rule will be discussed in Module 8.

- Contours should flow smoothly between observed values. For example, in the figure below, the 65 contour line should pass closer to the 63 observation on the left than the 69, then gradually swing down to near the 66 observation on the right.



- Spacing between contours should be as regular and even as possible. Remember, the atmosphere likes continuity, and we need to reflect this in our analyses.

CONTOURING EXAMPLES

The guidelines above give you an overview on how to perform contour analysis. However, simply reading the guidelines is similar to reading a book on how to swim. Books and other materials will give you a basic overview of map analysis, but the only way to really understand the technique is to practice it. This module will provide you with a few analysis examples.

EXAMPLE 1 -- SIMPLE CONTOURING

Figure 7-1 contains a plot of temperatures from an evenly-spaced network of stations. Following the guidelines given above, prepare a contour analysis of this temperature plot, with contours every two degrees (60, 62, 64, etc.). As a hint, draw the 70-degree contour first, then work your way down to the 56 degree contour. A completed example is shown in figure 7-2. Note that the temperature contours seem to form a "hump" oriented just to the right of the center of the grid. This is referred to as a **ridge**. A ridge is a linear-oriented area where the meteorological parameter (temperature, pressure, etc.) is higher than the surrounding areas. In Modules 8 and 9, we will discuss ridges and their counterparts, **troughs**, in more detail.

EXAMPLE 2 -- SURFACE MAP DEW POINT ANALYSIS

Figure 7-3 contains an actual surface plot for Texas and the surrounding states. This map is from 2300Z (6:00 PM CDT), June 1, 1990. A number of weather features are depicted on the map.

We'll concentrate on the moisture-related features by doing a dew point contour analysis. Again, don't worry about all the symbols on the map; the dew point is the number at the lower left corner of each station plot. Contour the values from 40 to 70 degrees using a contour interval of 5 degrees (40, 45, 50, etc.) for this analysis. As in the earlier example, locate a maximum or minimum area first, contour the maximum or minimum, then work your way up or down through the remainder of the dew point values. A completed example is shown in figure 7-4.

Looking at the wind observations and the dew point analysis, are there any significant features evident on this surface map? You should have had trouble fitting in all of the dew point contours near the Texas-New Mexico border. This is a reflection of the dryline discussed in Module 2. Has this helped focus your attention on where thunderstorms might develop? Are there any areas we can probably rule out regarding thunderstorm formation?

If we were to perform a temperature analysis (we'll give this a try in class), we would see some features which might assist us further in defining where storms may develop. Even without doing a complete analysis, we can "eyeball" the temperature field and observe some interesting contrasts. The temperature is depicted in the upper left corner of each station plot. Note that the temperature at Midland (southwest Texas) is 88 degrees, Abilene's temperature is 79 (west-central Texas), and the temperature at Childress (near the southwest corner of Oklahoma) is 68 degrees. This is a late afternoon in June? Clearly, there's quite a temperature difference between Midland and Childress.

If you look closely, there's a very slight difference in wind direction between San Angelo (southwest of Abilene, it's the station with a temperature of 83 degrees, dew point 71 degrees) and Abilene itself. These minor differences in temperature and small "wiggles" in the wind field may seem too small to be of concern. However, these minor changes, both at the surface and at upper levels, can sometimes mean the difference between a quiet spring afternoon and an afternoon with severe storms hammering the area.

EXAMPLE 3 -- UPPER-AIR ANALYSIS

Figure 7-5 is a portion of an upper-air plot. In this example, a computer analysis program has already drawn the height contours (solid lines) and the temperature contours (dashed lines). However, we would like to look at the pattern of height changes over the past 12 hours. Height changes are plotted in the lower right corner of each station plot. Contour all the height changes greater than +2 or less than -2 (i.e., -6, -4, -2, +2, +4,...). The analysis is shown in figure 7-6.

Height change analyses are important. Perhaps the most significant pattern in the height change field is the **rise-fall couplet**. A rise-fall couplet is an area of large height falls immediately to the east of an area of strong height rises. Rise-fall couplets suggest a strong, progressive upper-level low pressure area. These typically bring strong upper-level winds, cold mid- and upper-level air, and upward vertical motion across an area, thus enhancing the chances for strong or severe storms in the area. Recall from Modules 2 and 4 that these are all conditions favorable for the development of severe weather. Are any rise-fall couplets evident on this analysis? We'll discuss these upper-air plots in more detail in Module 9.

To summarize the fundamentals of contour analysis:

- Start with either the lowest or highest contour value, then work up or down through the remainder of the values.

- Almost all contours should be smoothly curved.

- Contours should smoothly flow between observed values.

- Spacing between contours should be as regular and even as possible.

- Practice, practice, practice!

In the forecast exercise and the "live" operations, you will be asked to do some contour plots and/or to interpret plots which have already been drawn. The more you practice these techniques, the more familiar you will become with the concepts involved, and the more comfortable you will be when the time comes to apply them.

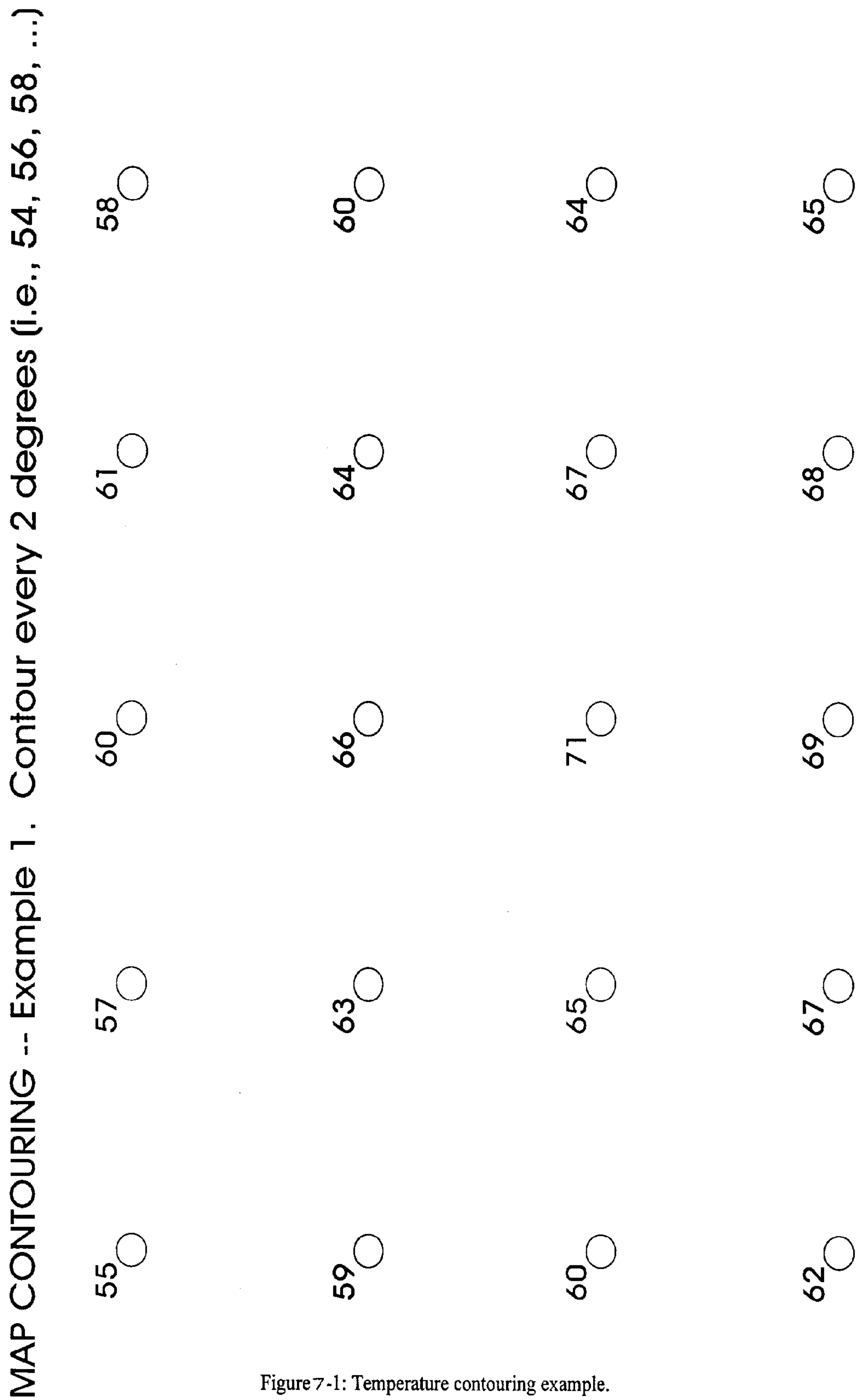


Figure 7-1: Temperature contouring example.

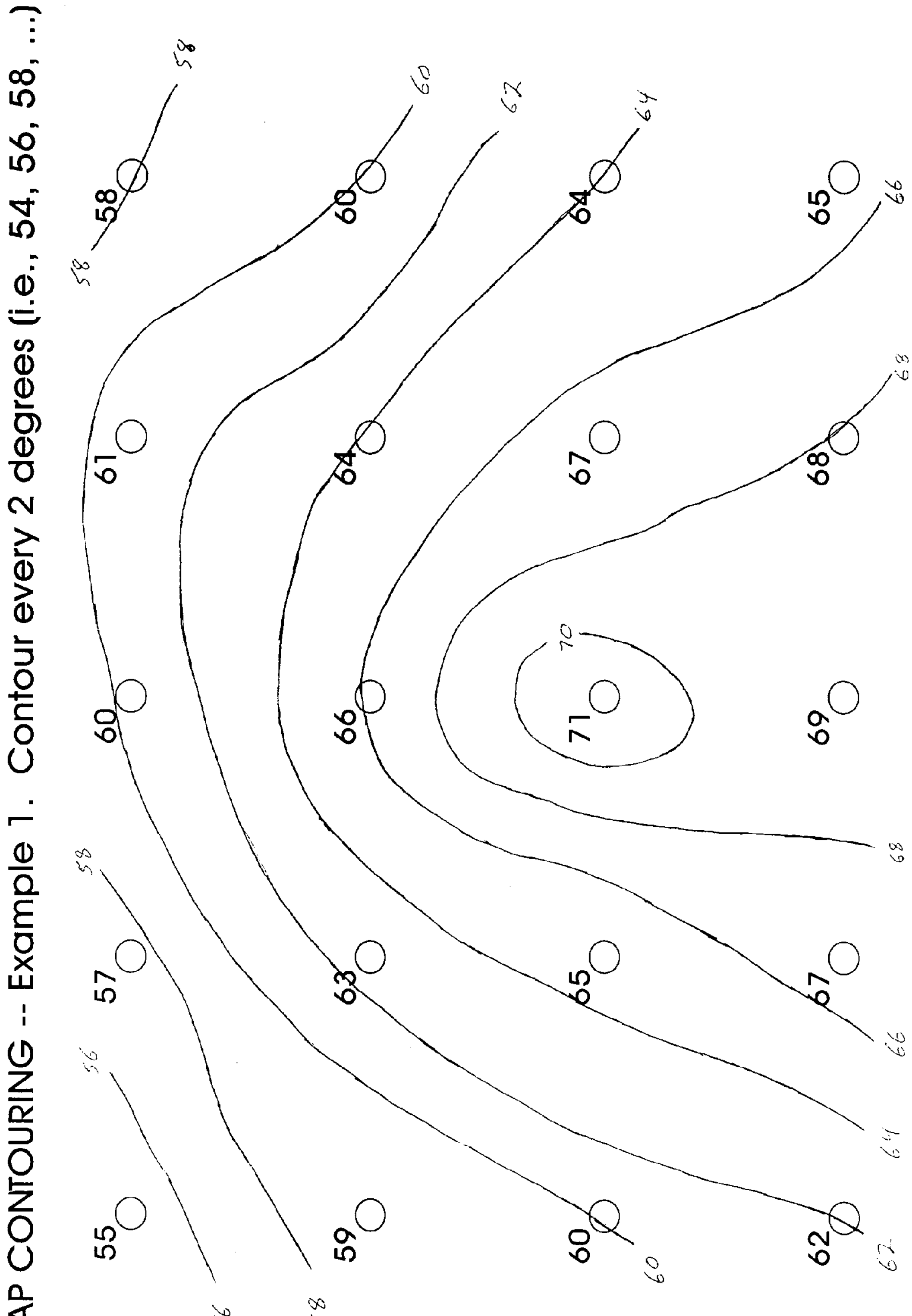


Figure 7-2: Temperature contouring example - solution.

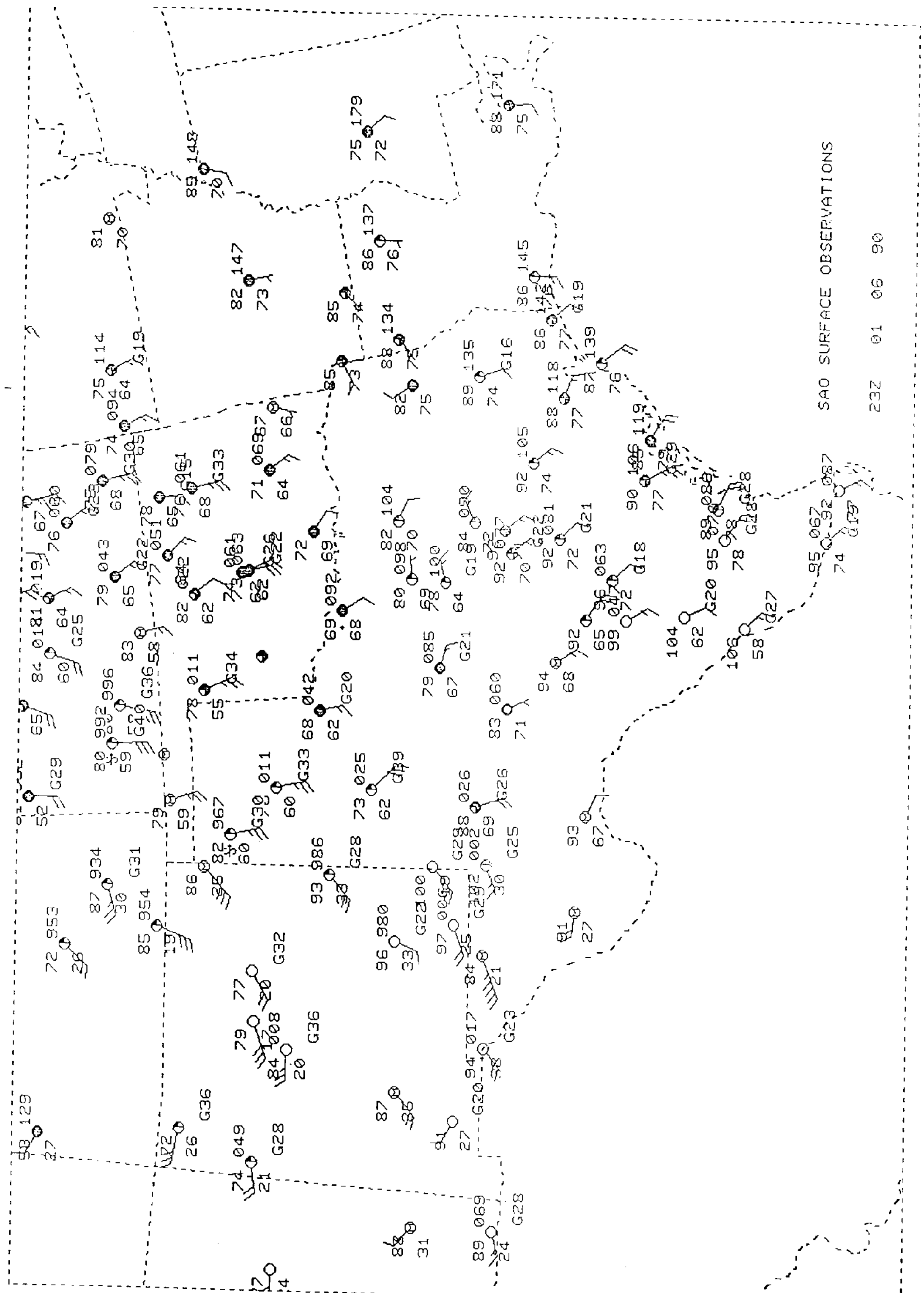


Figure 7-3: Surface dewpoint contouring example.

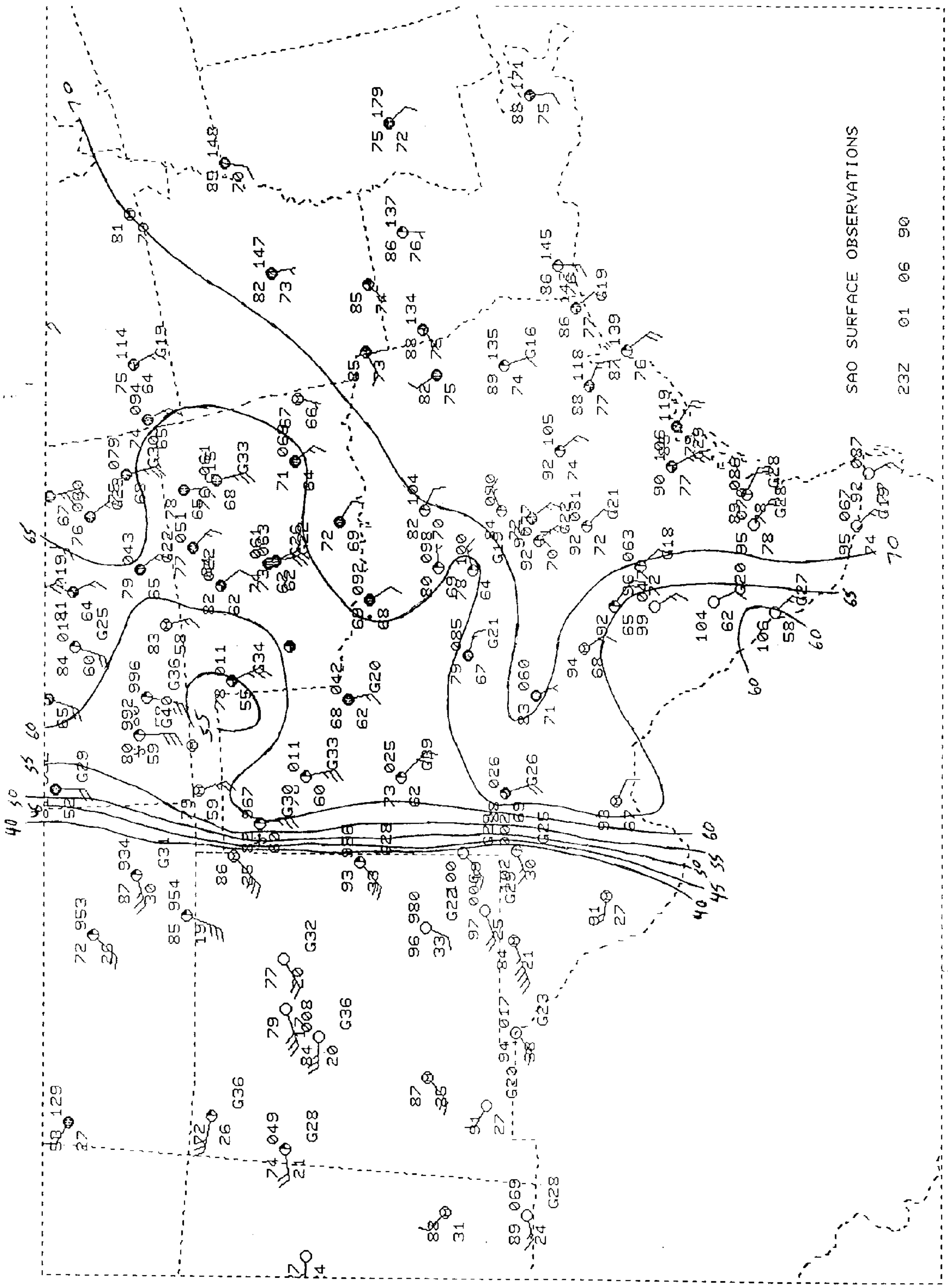


Figure 7-4: Surface dewpoint contouring solution.

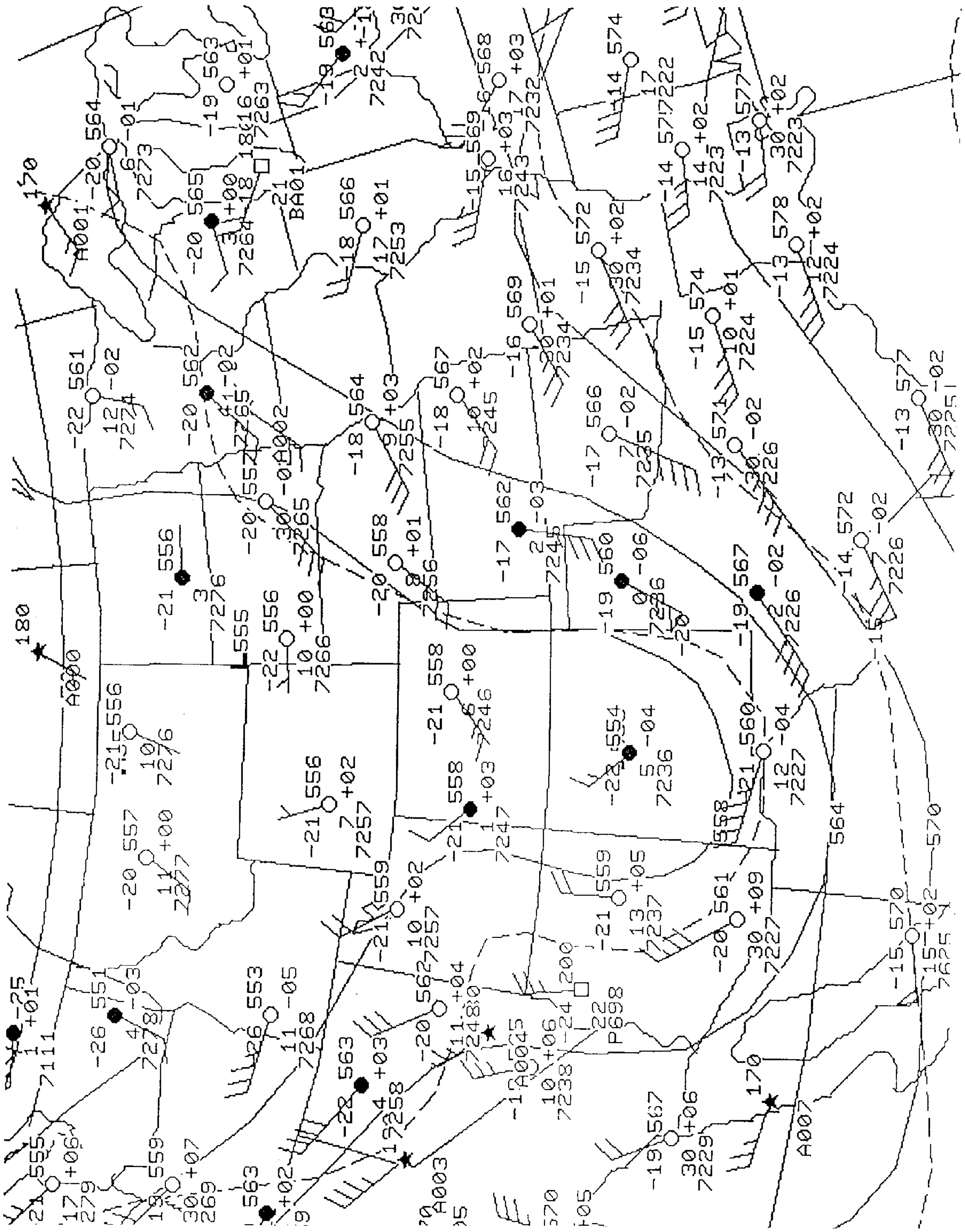


Figure 7-5: Upper height change contouring example.

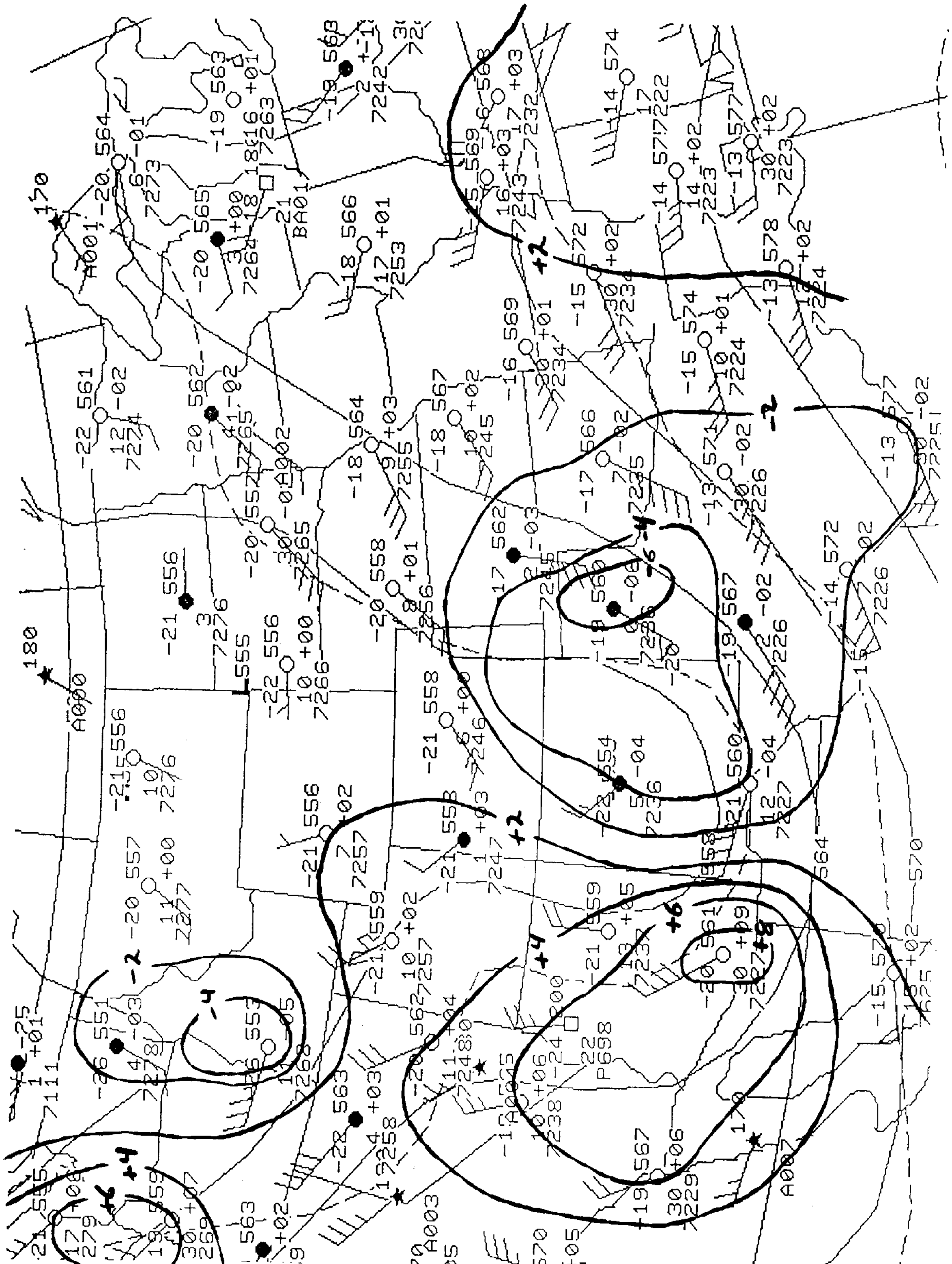


Figure 7-6: Upper contouring height change solution.